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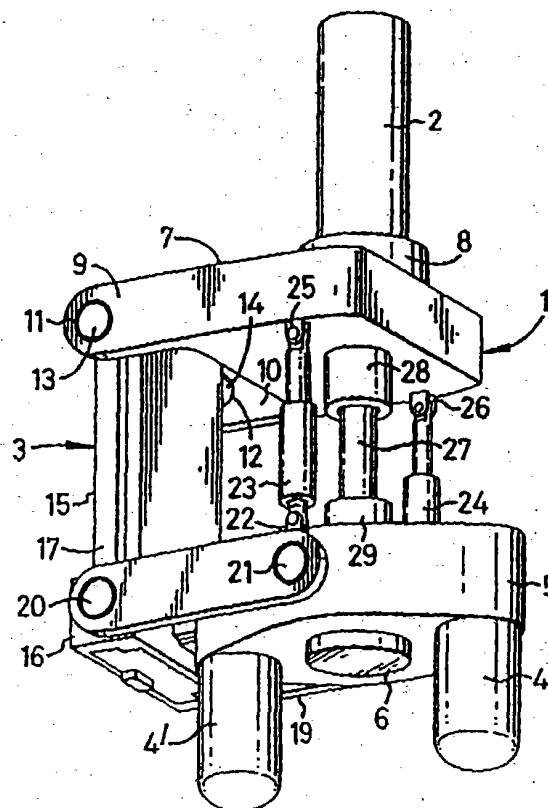
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: <b>PCT/GB99/02708</b></p> <p>(22) International Filing Date: <b>16 August 1999 (16.08.99)</b></p> <p>(30) Priority Data: <b>9818360.1</b>      <b>24 August 1998 (24.08.98)</b>      <b>GB</b></p> <p>(71) Applicant (for all designated States except US): <b>WEATHER-FORD/LAMB, INC. [US/US]; c/o CSC - The United States Corporation Company, 1013 Centre Road, Wilmington, DE 19805 (US).</b></p> <p>(71) Applicant (for GB only): <b>HARDING, Richard, Patrick [GB/GB]; Marks &amp; Clerk, 4220 Nash Court, Oxford Business Park South, Oxford OX4 2RU (GB).</b></p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): <b>PIETRAS, Bernd-Goerg [DE/DE]; Sandriedeweg 12, D-30900 Wedemark (DE).</b></p> <p>(74) Agent: <b>LIND, Robert; Marks &amp; Clerk, 4220 Nash Court, Oxford Business Park South, Oxford OX4 2RU (GB).</b></p>	<p>(81) Designated States: <b>AU, CA, GB, NO, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</b></p> <p><b>Published</b> <i>With international search report.</i></p>	

(54) Title: **AN APPARATUS FOR CONNECTING TUBULARS USING A TOP DRIVE**

(57) Abstract

An apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising a motor (4, 4') for rotating a tool (30) for drivingly engaging a tubular, and means (3) for connecting said motor (4, 4') to said top drive, the apparatus being such that, in use, said motor (4, 4') can rotate one tubular with respect to another to connect said tubular.



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## AN APPARATUS FOR CONNECTING TUBULARS USING A TOP DRIVE

This invention relates to an apparatus for facilitating the connection of tubulars using a top drive and is more particularly, but not exclusively, intended for facilitating the  
5 connection of a section or stand of casing to a string of casing.

In the construction of oil or gas wells it is usually necessary to line the borehole with a string of tubulars known as a casing. Because of the length of the casing required, sections or stands of say two sections of casing are progressively added to the string as it is lowered into the well from a drilling platform. In particular, when it is  
10 desired to add a section or stand of casing the string is usually restrained from falling into the well by applying the slips of a spider located in the floor of the drilling platform. The new section or stand of casing is then moved from a rack to the well centre above the spider. The threaded pin of the section or stand of casing to be  
15 connection is made up by rotation there between. An elevator is then connected to the top of the new section or stand and the whole casing string lifted slightly to enable the slips of the spider to be released. The whole casing string is then lowered until the top of the section is adjacent the spider whereupon the slips of the spider are re-applied, the elevator disconnected and the process repeated.

20 It is common practice to use a power tong to torque the connection up to a predetermined torque in order to make the connection. The power tong is located on a platform, either on rails, or hung from a derrick on a chain. However, it has recently been proposed to use a top drive for making such connection. The normal use of such a top drive may be the driving of a drill string.

A problem associated with using a top drive for rotating tubulars in order to obtain a connection between tubulars is that some top drives are not specifically designed for rotating tubulars are not able to rotate at the correct speed or have non standard rotors.

5        According to the present invention there is provided an apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising a motor for rotating a tool for drivingly engaging a tubular, and means for connecting said motor to said top drive, the apparatus being such that, in use, said motor can rotate one tubular with respect to another to connect said tubulars.

10        Other features of the invention are set out in Claims 2 et seq.

For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

15        Figure 1 is a front perspective view of an apparatus in accordance with the present invention; and

Figure 2 is a rear perspective view of the apparatus of Figure 1 in use.

Referring to Figure 1 there is shown an apparatus which is generally identified by reference numeral 1.

20        The apparatus 1 comprises a connecting tubular 2, a suspension unit 3 and a hydraulic motor 4 and 4'. The hydraulic motor 4,4' has a stator 5 and a rotor 6 and is driven by a supply of pressurised hydraulic fluid (the fluid supply lines are not illustrated in the Figures). The suspension unit 3 suspends the hydraulic motor 4,4' from the connecting tubular 2.

The suspension unit 3 comprises a plate 7 which is fixed to the connecting tubular 2 by a collar 8. The plate 7 has two projections 9 and 10 which have holes 11 and 12 for accommodating axles 13 and 14, which are rotationally disposed therein. The axles 13 and 14 are integral with a rigid body 15. A slider 16 is arranged on runners 17 and (not shown) on the rigid body 15. Arms 18 and 19 are connected at one end to the slider 16 via spherical bearings 20 and at the other end to each side of the stator 5 via spherical bearings 21 and 21'. The arms 18 and 19 are provided with lugs 22 and 22' to which one end of a piston and cylinder 23, 24 is attached and are movable thereabout. The other end of each piston and cylinder 23, 24 is attached to lugs 25, 26 respectively and is movable thereabout. A mud pipe 27 is provided between the plate 7 and the stator 5 for carrying mud to the inside of a tubular therebelow. The mud pipe 27 comprises curved outer surfaces at both ends (not shown) which are located in corresponding recesses in cylindrical sections 28, 29, thus allowing a ball and socket type movement between the plate 7 and the stator 5.

Referring to Figure 2, the apparatus 1 is suspended from a top drive (not shown) via connecting shaft 2. A tool 30 for engaging with a tubular is suspended from beneath the rotor 6 of the hydraulic motor 4. Such a tool may be arranged to be inserted into the upper end of the tubular, with gripping elements of the tool being radially displaceable for engagement with the inner wall of the tubular so as to secure the tubular to the tool.

In use, a tubular (not shown) to be connected to a tubular string held in a spider (not shown) is located over the tool 30. The tool 30 grips the tubular. The apparatus 1 and the tubular are lowered by moving the top drive so that the tubular is in close proximity with the tubular string held in the spider. However, due to amongst other things manufacturing tolerances in the tubulars, the tubular often does not align

perfectly with the tubular held in the spider. The suspension unit 3 allows minor vertical and horizontal movements to be made by using alignment pistons 31 and 32 for horizontal movements, and piston and cylinders 23 and 24 for vertical movements. The alignment piston 31 acts between the rigid body 15 and the plate 7. The alignment  
5 piston 32 acts between the slider 16 and the arm 19. The alignment pistons 31 and 32 and pistons and cylinders 23, 25 are actuated by hydraulic or pneumatic means and controlled from a remote control device.

The piston and cylinders 23, 24 are hydraulically operable. It is envisaged however, that the piston and cylinders 23, 24 may be of the pneumatic compensating  
10 type, i.e. their internal pressure may be adjusted to compensate for the weight of the tubular so that movement of the tubular may be conducted with minimal force. This can conveniently be achieved by introducing pneumatic fluid into the piston and cylinder 23, 24 and adjusting the pressure therein.

Once the tubulars are aligned, the hydraulic motor 4 and 4' rotate the tubular via  
15 gearing in the stator 5 thereby making up the severed connection. During connection the compensating piston and cylinders 23, 24 expand to accommodate the movement of the upper tubular. The alignment pistons 31 and 32 can then be used to move the top of the tubular into alignment with the top drive. If necessary, final torquing can be conducted by the top drive at this stage, via rotation of the pipe 27, and the main  
20 elevator can also be swung onto and connected to the tubular prior to releasing the slips in the spider and lowering the casing string. It will be appreciated that the suspension unit 3 effectively provides an adapter for connecting a top drive to the tubular engaging tool 30.

## CLAIMS

1. Apparatus for facilitating the connection of tubulars using a top drive, the apparatus comprising a motor (4, 4') for rotating a tool (30) for drivingly engaging a tubular, and means (3) for connecting said motor (4, 4') to said top drive, the apparatus being such that, in use, said motor (4, 4') can rotate one tubular with respect to another to connect said tubulars.
2. An apparatus as claimed in Claim 1, wherein said motor is hydraulically operable.
3. An apparatus as claimed in Claim 1 or 2, wherein said means comprises a suspension unit (3) which, in use, can move said motor relative to the axis of said top drive to facilitate aligning said tubulars.
4. An apparatus as claimed in Claim 3, wherein said suspension unit (3) is provided with at least one piston and cylinder (23, 24) in order to raise and lower said motor (4, 4').
5. An apparatus as claimed in Claim 4, wherein said at least one piston and cylinder can be pneumatically actuated to compensate for the weight of said tubular.
6. An apparatus as claimed in Claim 3, 4 or 5, wherein said suspension unit (3) comprises spherical bearings (20, 21) to allow movement of said motor in two planes.

7. An apparatus as claimed in any of claims 3 to 6, wherein said suspension unit (3) comprises adjustable pistons and cylinders (31, 32) to position said motor (4, 4').

5 8. An apparatus as claimed in any preceding claim, comprising a mud pipe (27) for delivering mud to said tubular.

9. An apparatus as claimed in Claim 8, wherein said mud pipe (27) is provided with a ball joint (28, 29) at both ends thereof.

10

10. An apparatus as claimed in any preceding claim, when supported by a top drive.

11. A method of connecting first and second tubulars for use in lining a borehole, the method comprising:

15 coupling said first tubular to a top drive using a suspension unit, wherein the tubular engages the rotor of a motor supported by the suspension unit;

engaging a lower end of said first tubular with an upper end of said second tubular;

rotating said first tubular using the motor so as to screw the tubulars together;

20 and

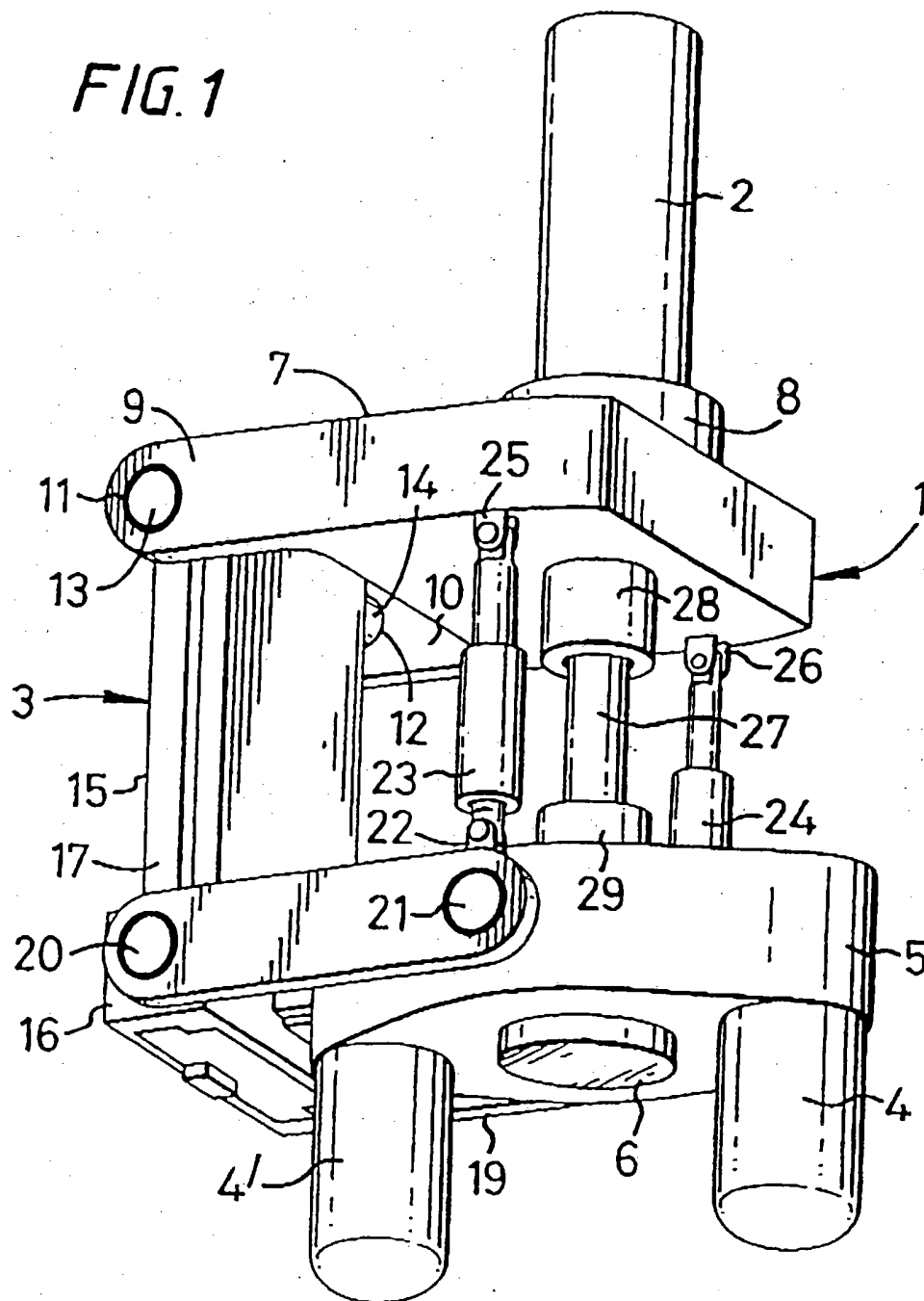
tightening the connection between the tubulars by rotating the first tubular using the top drive.



12. A method according to claim 11, the method comprising adjusting the suspension unit prior to tightening the connection using the top drive so as to bring the first tubular into alignment with the top drive.

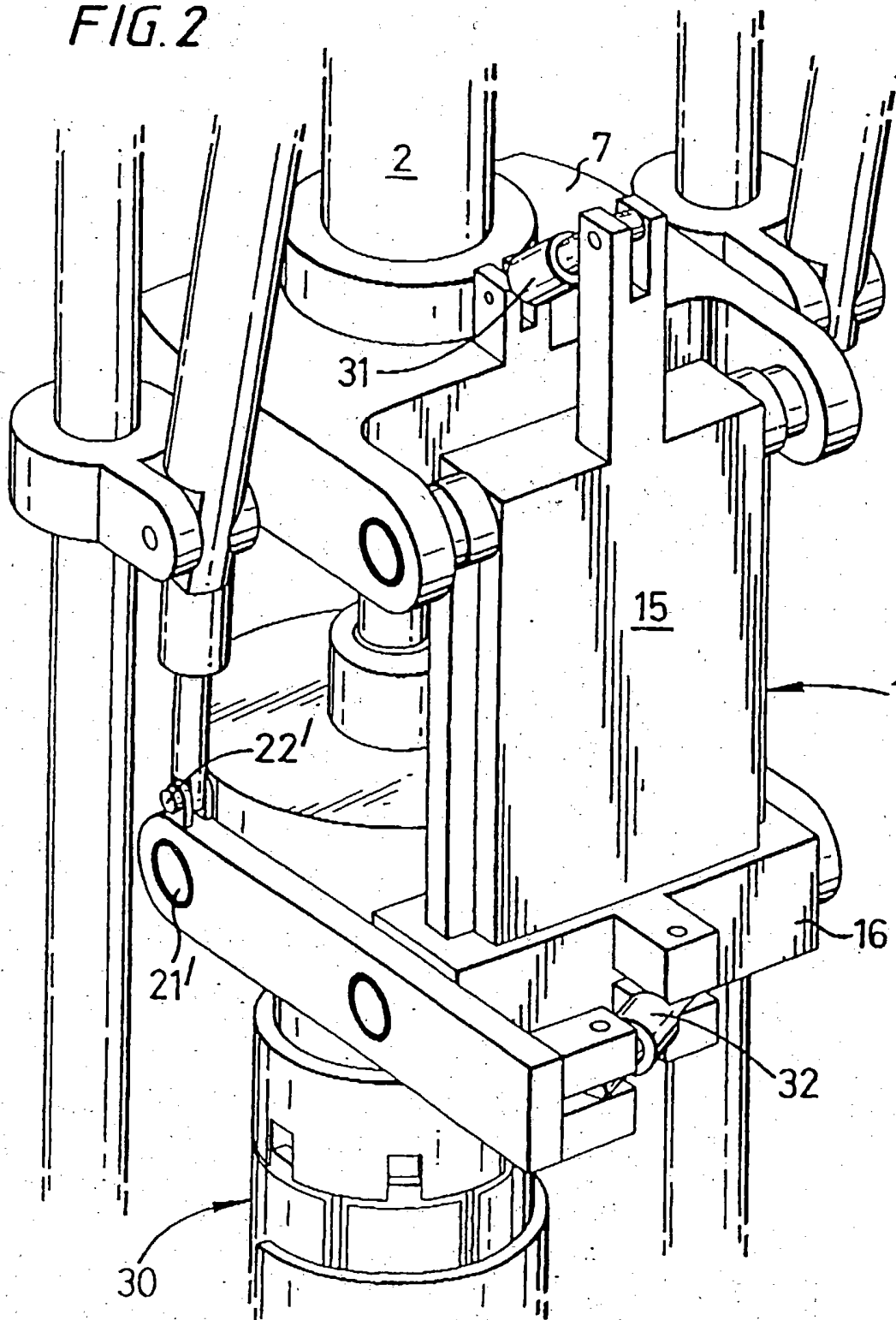
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FIG. 1



2/2

FIG. 2



## INTERNATIONAL SEARCH REPORT

International Application No

I 7/GB 99/02708

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 E21B19/16

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages.	Relevant to claim No.
X	US 4 625 796 A (BOYADJIEFF GEORGE I) 2 December 1986 (1986-12-02) column 3, line 19-52 column 6, line 1-21 figures 1,2 ---	1,2,8
X	US 4 449 596 A (BOYADJIEFF GEORGE I) 22 May 1984 (1984-05-22) column 11, line 33-59 ---	1,8
X	US 3 766 991 A (BROWN C) 23 October 1973 (1973-10-23) abstract column 5, line 13-42 figure 1B --- -/--	1



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

19 November 1999

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# INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 813 493 A (SHAW DANIAL G ET AL) 21 March 1989 (1989-03-21) abstract; figure 1 ---	1,11
A	US 5 388 651 A (BERRY JOE R) 14 February 1995 (1995-02-14) column 7-8 figures 1,2 -----	1,11

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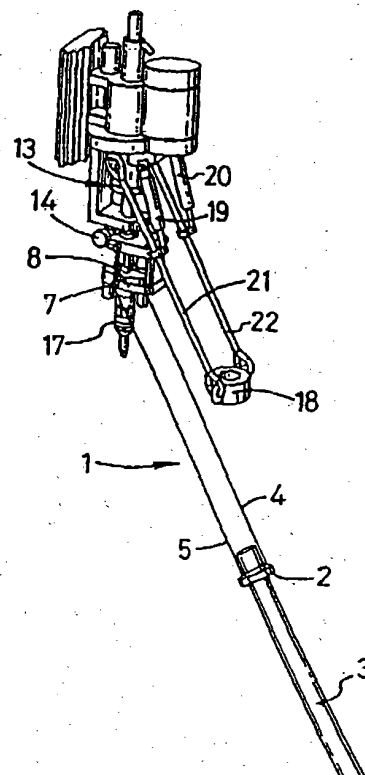
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<p>(21) International Application Number: PCT/GB99/02704 (22) International Filing Date: 16 August 1999 (16.08.99) (30) Priority Data: 9818366.8 24 August 1998 (24.08.98) GB (71) Applicant (for all designated States except US): WEATHER-FORD/LAMB, INC. [US/US]; CSC - The United States Corporation Company, 1013 Centre Road, Wilmington, DE 19805 (US). (71) Applicant (for GB only): HARDING, Richard, Patrick [GB/GB]; Marks &amp; Clerk, 4220 Nash Court, Oxford Business Park South, Oxford OX4 2RU (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): PIETRAS, Bernd-Georg [DE/DE]; Sandriedeweg 12, D-30900 Wedemark (DE). (74) Agent: LIND, Robert; Marks &amp; Clerk, 4220 Nash Court, Oxford Business Park South, Oxford OX4 2RU (GB).</p>		<p>(81) Designated States: AU, CA, GB, NO, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  Published With international search report.</p>

(54) Title: METHOD AND APPARATUS FOR CONNECTING TUBULARS USING A TOP DRIVE

(57) Abstract

An apparatus for facilitating the connection of tubulars, said apparatus comprising a winch (15), at least one wire line (4, 5) and a device (2) for gripping a tubular (3), the arrangement being such that, in use, the winch (15) can be used to winch said at least one wire (4, 5) and said device (2) to position a tubular (3) below said top drive.



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## METHOD AND APPARATUS FOR CONNECTING TUBULARS USING A TOP DRIVE

This invention relates to a method and apparatus for facilitating the connection of tubulars using a top drive and is, more particularly but not exclusively, for facilitating the connection of a section or stand of casing to a string or casing.

In the construction of wells such as oil or gas wells, it is usually necessary to line predrilled holes with a string of tubulars known as casing. Because of the size of the casing required, sections or stands of say two sections of casing are connected to each other as they are lowered into the well from a platform. The first section or stand of casing is lowered into the well and is usually restrained from falling into the well by a spider located in the platform's floor. Subsequent sections or stands of casing are moved from a rack to the well centre above the spider. The threaded pin of the section or stand of casing to be connected is located over the threaded box of the casing in the well to form a string of casing. The connection is made-up by rotation therebetween.

It is common practice to use a power tong to torque the connection up to a predetermined torque in order to perfect the connection. The power tong is located on the platform, either on rails, or hung from a derrick on a chain. However, it has recently been proposed to use a top drive for making such connection.

Prior to the present invention, pipe handling devices moved pipes to be connected to a tubular string from a rack to the well centre using articulated arms or, more commonly, a pipe elevator suspended from the drilling tower.

The present invention provides an alternative to these devices.

Accordingly, a first aspect of the present invention provides an apparatus for facilitating the connection of tubulars, said apparatus comprising a winch, at least one wire line and a device for gripping a tubular the arrangement being such that, in use, the winch can be used to winch said at least one wire and said device to position a tubular  
5 below said top drive.

Further features are set out in Claims 2 to 6.

According to a second aspect of the present invention there is provided a method of facilitating the connection of tubulars using a top drive and comprising the steps of attaching at least one wire to a tubular, the wire depending from the top drive or from a  
10 component attached thereto, and winching the wire and the tubular upwards to a position beneath the top drive.

According to a third aspect of the present invention there is provided an apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising an elevator and a pair of bails, characterised in that said elevator is, in use,  
15 movable in relation to said pair of bails.

According to a fourth aspect of the present invention there is provided an apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising an elevator (102) and a pair of bails (103, 104), characterised in that said elevator (102) is, in use, movable relative to said pair of bails (103, 104).

20 For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings in which:

Figures 1a to 1e are perspective views of an apparatus in accordance with a first embodiment of the present invention at various stages of operation; and

Figures 2a to 2d are perspective views of an apparatus in accordance with a second embodiment of the invention at various stages of operation.

Referring to Figures 1a to 1e there is shown an apparatus which is generally identified by reference numeral 1.

5       The apparatus 1 comprises a clamp 2 for retaining a tubular 3. The clamp 2 is suspended on wires 4, 5 which are connected thereto on opposing sides thereof. The wire 5 passes through an eye 6 in lug 7 which is attached to a spherical bearing in arm 8 of a suspension unit 9 at the point at which the arm 8 is connected to a hydraulic motor 10. The wire is connected to the hydraulic motor 10 in a corresponding manner. The  
10       suspension unit 9 is of a type which enables displacement of the tubular 3 when connected to a tool 17 (see below), relative to a top drive 13, along a number of different axes. The wires 4, 5 pass across the suspension unit 9 and over pulley wheels 11 which are rotatably arranged on a plate 12. The plate 12 is fixed in relation to a top drive generally identified by reference numeral 13. The wires 4, 5 then pass over drums  
15       14 to which the wires 4, 5 are also connected. The drums 14 are rotatable via a hydraulic winch motor 15.

In use, the clamp 2 is placed around a tubular below a box 16 thereof. The hydraulic winch motor 15 is then activated, which lifts the tubular 3 (conveniently from a rack) and towards a tool 17 for gripping the tubular 3 (Fig. 1b). The tubular 3  
20       encompasses the tool 17 at which point the hydraulic winch motor 15 is deactivated (Fig. 1c). During this operation the elevator 18 is held away from the tool 17 by piston and cylinders 19, 20 acting on bails 21 and 22. The suspension unit 9 allows the hydraulic motor 10 and the arrangement depending therebelow to move in vertical and horizontal planes relative to the top drive 13. The eyes 6 in lugs 7 maintain the wires 4

and 5 in line with the tubular 3 during any such movement. The tool 17 may now be used to connect the tubular to the tubular string. More particularly, the tool may be of a type which is inserted into the upper end of the tubular, with gripping elements of the tool being radially displaceable for engagement with the inner wall of the tubular so as to secure the tubular to the tool. Once the tool is secured to the tubular, the hydraulic motor 10 is activated which rotates the tool 17 and hence the tubular 3 for engagement with a tubular string held in a spider.

The clamp 2 is now released from the tubular 3, and the top drive 13 and hence apparatus 1 is now lifted clear of the tubular 3. The elevator 18 is now swung in line with the apparatus 1 by actuation of the piston and cylinders 19 and 20 (Fig. 1d).

The top drive 13 is then lowered, lowering the elevator 18 over the box 16 of the tubular 3. The slips in the elevator 18 are then set to take the weight of the entire tubular string. The top drive is then raised slightly to enable the slips in the spider to be released and the top drive is then lowered to introduce the tubular string into the borehole.

Referring to Figures 2a to 2d there is shown an apparatus which is generally identified by reference numeral 101.

The apparatus 101 comprises an elevator 102 arranged at one end of bails 103, 104. The bails 103, 104 are movably attached to a top drive 105 via axles 106 which are located in eyes 107 in the other end of the bails 103, 104. Piston and cylinders 108, 109 are arranged between the top drive 105 and the bails. One end of the piston and cylinders 108, 109 are movably arranged on axles 110 on the top drive. The other end of the piston and cylinders 108, 109 are movably arranged on axles 111, 112 which are

located in lugs 113, 114 located approximately one-third along the length of the bails 103, 109.

The elevator 102 is provided with pins 115 on either side thereof and projecting therefrom. The pins 115 are located in slots 116 and 116a. A piston 117, 118 and cylinder 119, 120 are arranged in each of the bails 103, 104. The cylinders are arranged in slot 121, 122. The piston 117, 118 are connected at their ends to the pins 115. The cylinders 119, 120 are prevented from moving along the bails 103, 104 by cross members 123 and 124. A hole is provided in each of the cross members to allow the pistons to move therethrough.

In use, a tubular 125 is angled from a rack near to the well centre. The tubular may however remain upright in the rack. The clamp 102 is placed around the tubular below a box 126 (Figure 2a). The top drive is raised on a track on a derrick. The tubular is lifted from the rack and the tubular swings to hang vertically (Figure 2b). The piston and cylinders 108, 109 are actuated, extending the pistons allowing the bails 103, 104 to move to a vertical position. The tubular 125 is now directly beneath a tool 127 for internally gripping and rotating the tubular 125 (Figure 2c). The pistons 117, 118 and cylinders 119, 120 are now actuated. The pins 115 follow slot 116 and the clamp 102 moves upwardly, lifting the tubular 125 over the tool 127 (Figure 2d). The tool 127 can now be actuated to grip the tubular 125.

At this stage the elevator 102 is released and the top drive 105 lowered to enable the tubular 125 to be connected to the string of tubulars in the slips and torqued appropriately by the top drive 105.

The pistons 117, 118 and cylinders 119, 120 are meantime extended so that after the tubular 125 has been connected the top drive 105 can be raised until the elevator 102

is immediately below the box. The elevator 102 is then actuated to grip the tubular 125 firmly. The top drive 105 is then raised to lift the tubular string sufficiently to enable the wedges in the slips to be withdrawn. The top drive 105 is then lower to the drilling platform, the slips applied, the elevator 102 raised for the tubular 125 and the process

5    repeated.

## CLAIMS

1. An apparatus for facilitating the connection of tubulars using a top drive and comprising a winch (15), at least one wire (4, 5), and a device (2) for gripping a tubular (3), the arrangement being such that, in use, the winch (15) can be used to winch said at least one wire (4, 5) and said device (2) to position a tubular (3) below said top drive.
2. An apparatus as claimed in Claim 1, further comprising a suspension unit (9) for coupling the tubular to the top drive.
3. An apparatus as claimed in Claim 2, wherein said suspension unit (9) has a static part fixed with respect to a top drive and a dynamic part movable relative thereto.
4. An apparatus as claimed in Claim 3, wherein said winch (15) is located on said static part of said suspension unit (9).
5. An apparatus as claimed in Claim 4, comprising a guide (7) located on said dynamic part (8) of said suspension unit (9).
6. An apparatus as claimed in Claim 5, comprising a pulley wheel (11) on said static part of said suspension unit (9).
7. A method of facilitating the connection of tubulars using a top drive and comprising the steps of attaching at least one wire to a tubular, the wire depending from

the top drive or from a component attached thereto, and winching the wire and the tubular upwards to a position beneath the top drive.

8. An apparatus for facilitating the connection of tubulars using a top drive, said  
5 apparatus comprising an elevator (102) and a pair of bails (103, 104), characterised in that said elevator (102) is, in use, movable relative to said pair of bails (103, 104).

9. An apparatus as claimed in Claim 8, wherein, in use, said elevator (102) is movable along said pair of bails (103, 104).

10

✓ 10. An apparatus as claimed in Claim 8 or 9, further comprising a piston (117, 118) and cylinder (119, 120) operatively connected between said pair of bails (103, 104) and said elevator (102).

15 11. An apparatus as claimed in Claim 10, wherein said piston (117, 118) and cylinder (119, 120) are pneumatically or hydraulically operable.

✓ 12. An apparatus as claimed in any of Claims 8 to 11, wherein said pair of bails (103, 104) comprise slots (116, 116a) in which pins (115) of said elevator (102) are  
20 arranged.

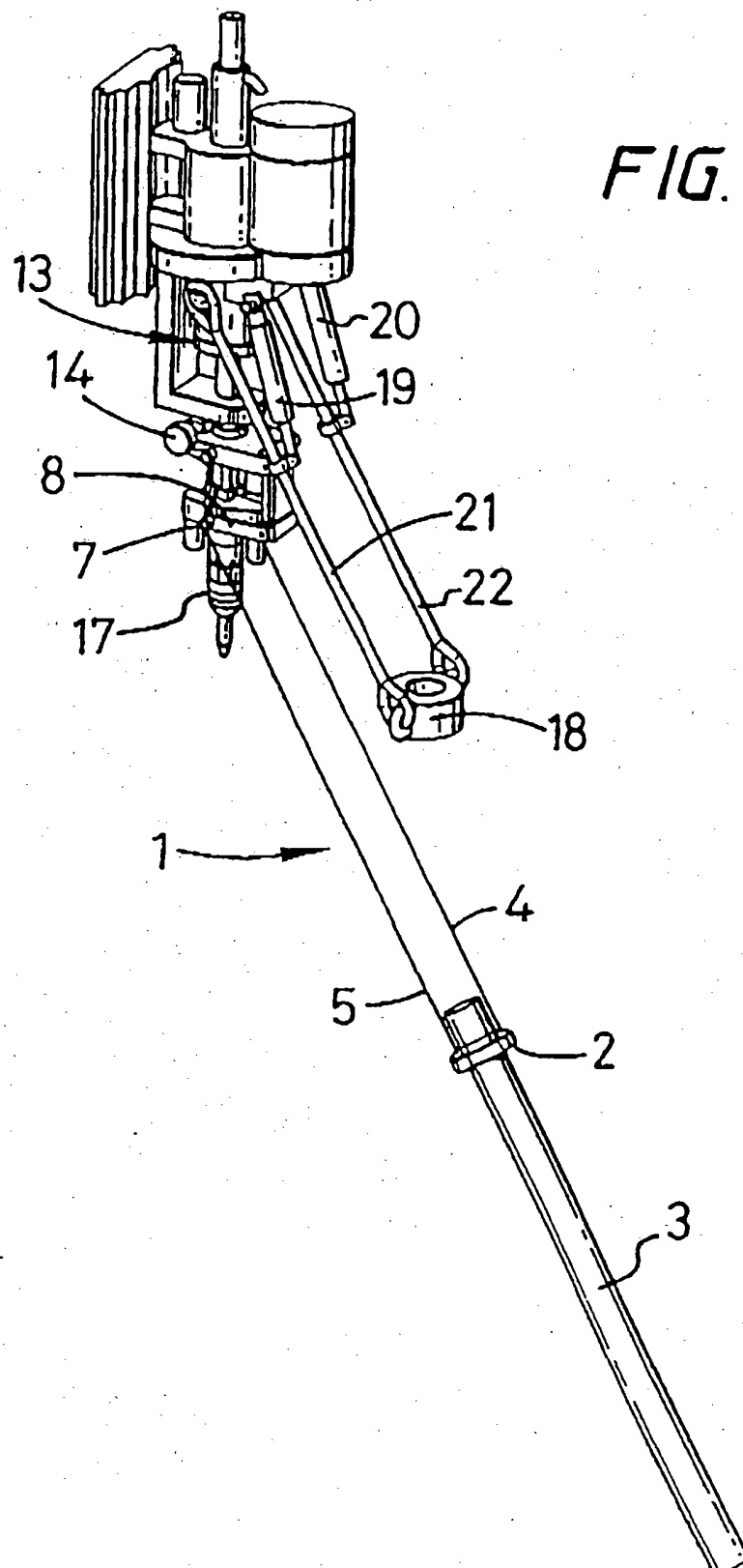
✓ 13. An apparatus as claimed in any of Claims 8 to 12, wherein said pair of bails (103, 104) are attached to a top drive on an axle (106) and are movable thereabout.



14. An apparatus as claimed in Claim 13, further comprising at least one piston and cylinder (108, 109) for moving said pair of bails (103, 104) and said axle (106).
15. A method for facilitating the connection of tubulars using a top drive, said  
5 method comprising the step of using an elevator to move a tubular to a position below said top drive, wherein the elevator depends from the top drive or from a component attached thereto.
16. A method according to Claim 15, wherein the elevator is connected to the top  
10 drive or to said component by way of a pair of bails, the method comprising the step of using said elevator to move said tubular in relation to said pair of bails towards or away from a tool for gripping said tubular.

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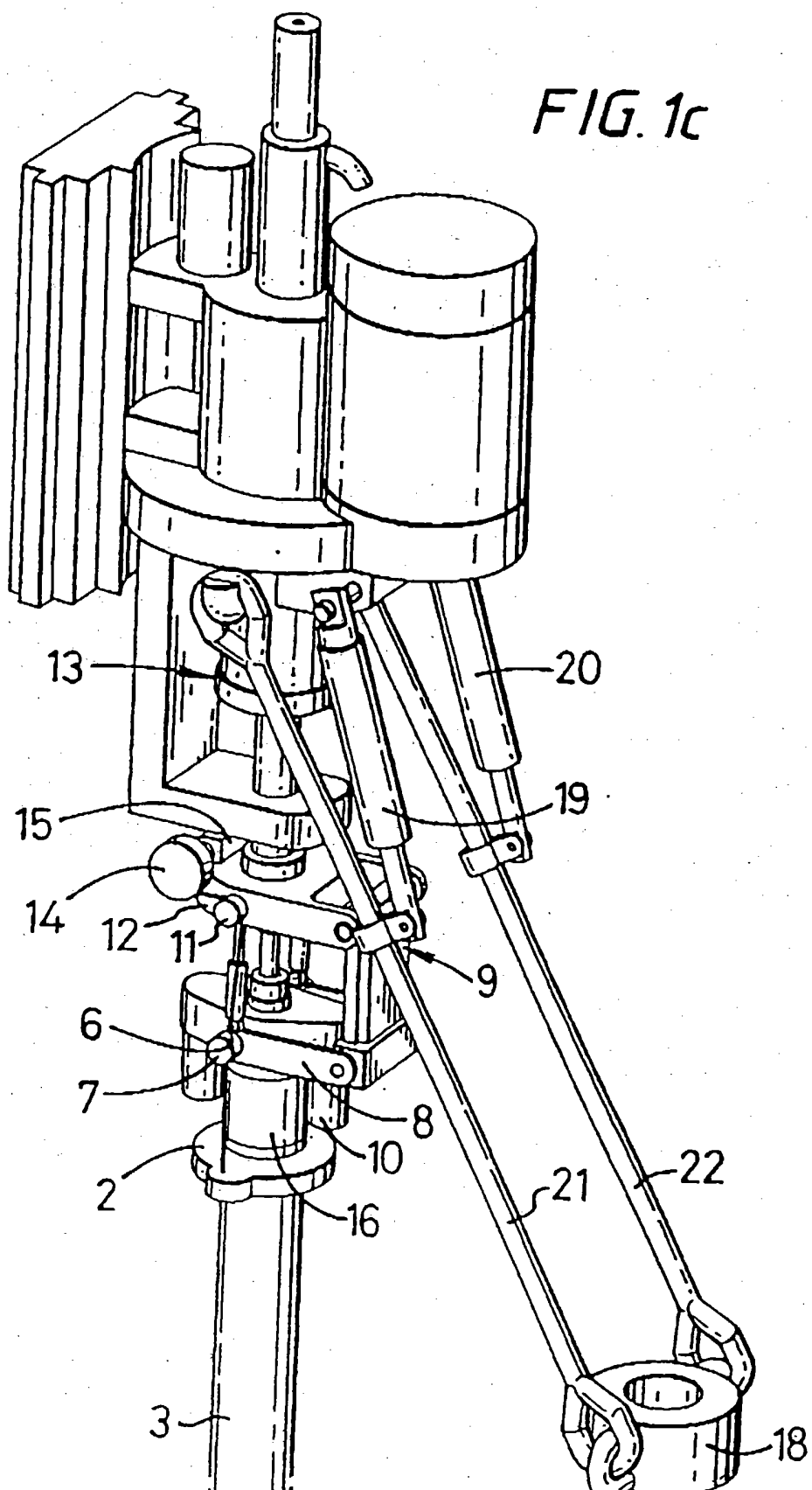
FIG. 1a





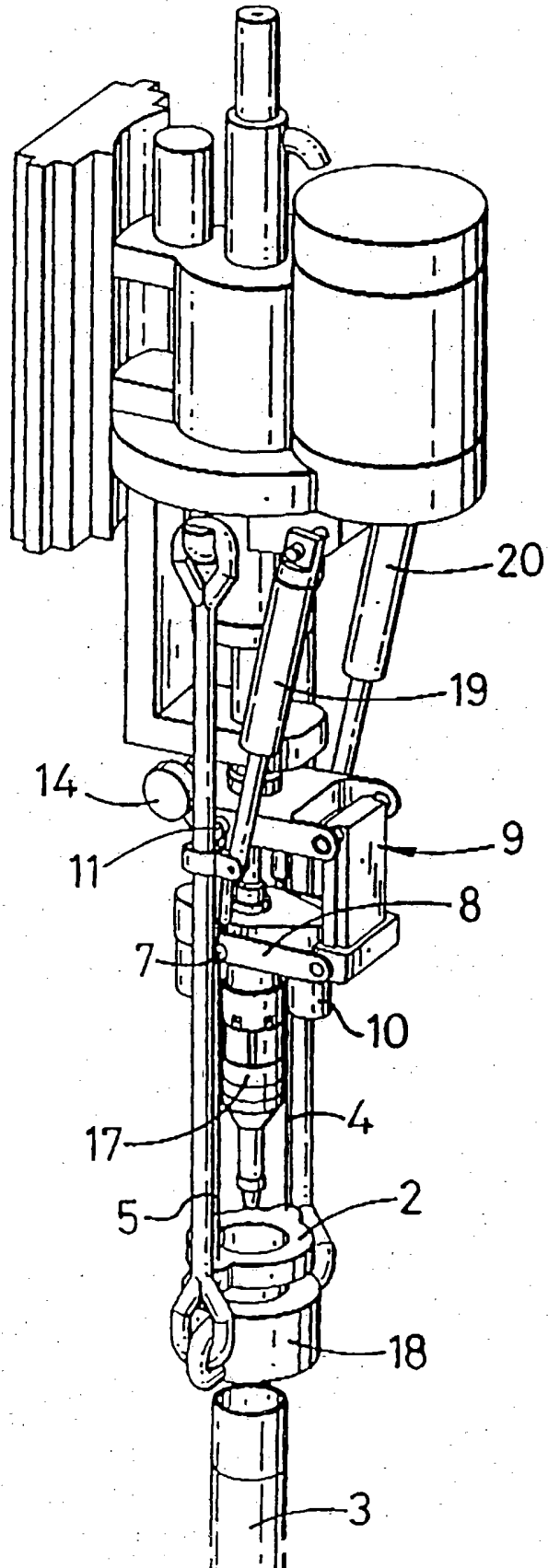
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FIG. 1c



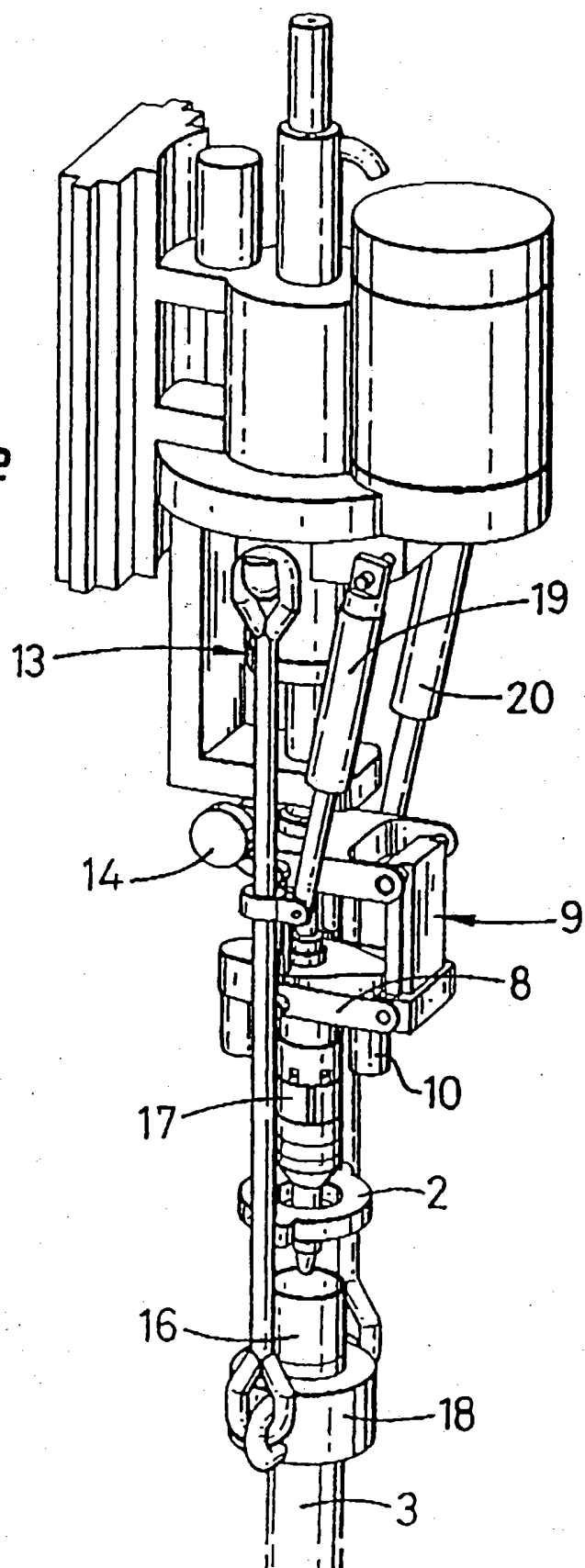
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FIG. 1d

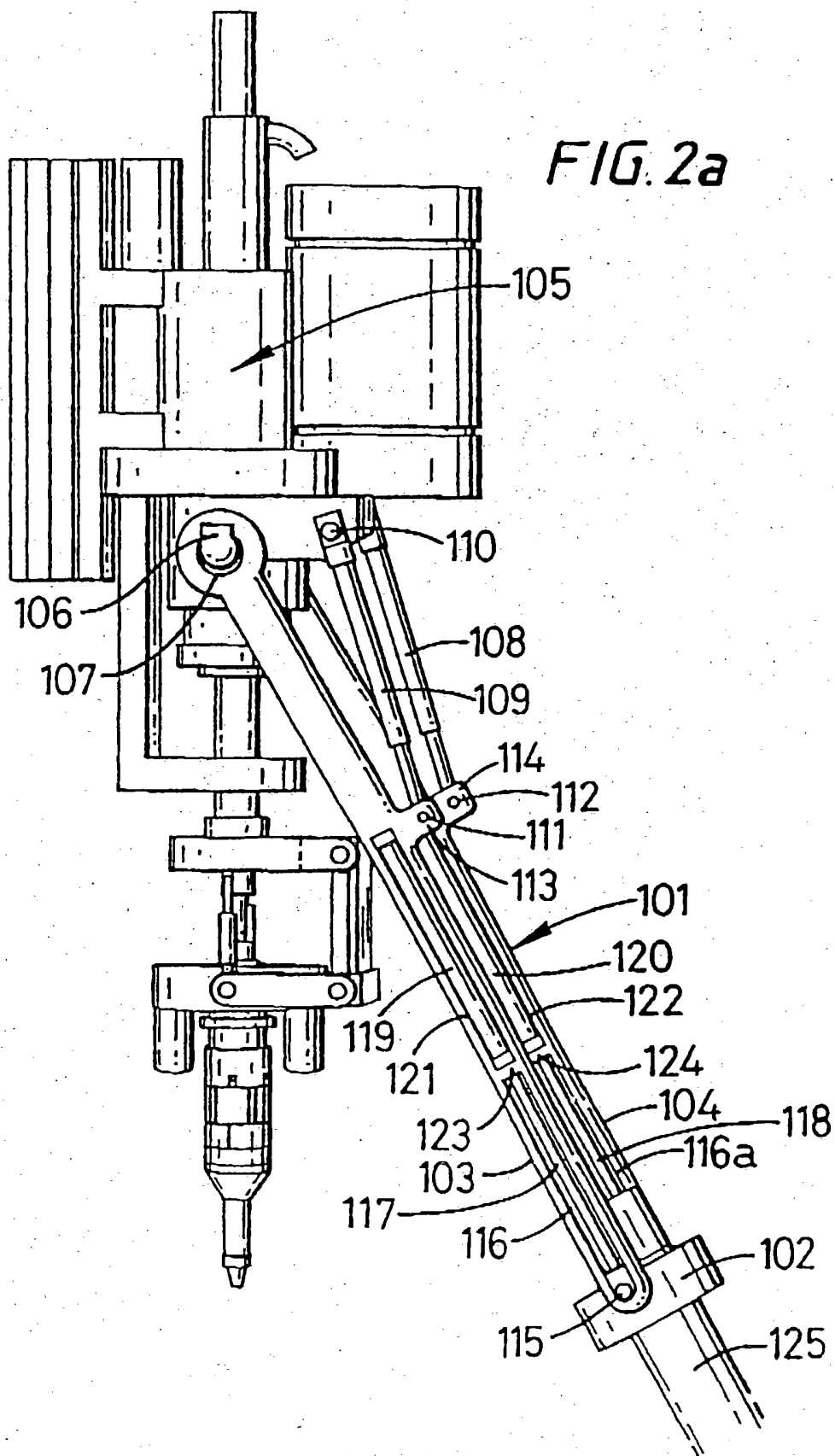


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FIG. 1e

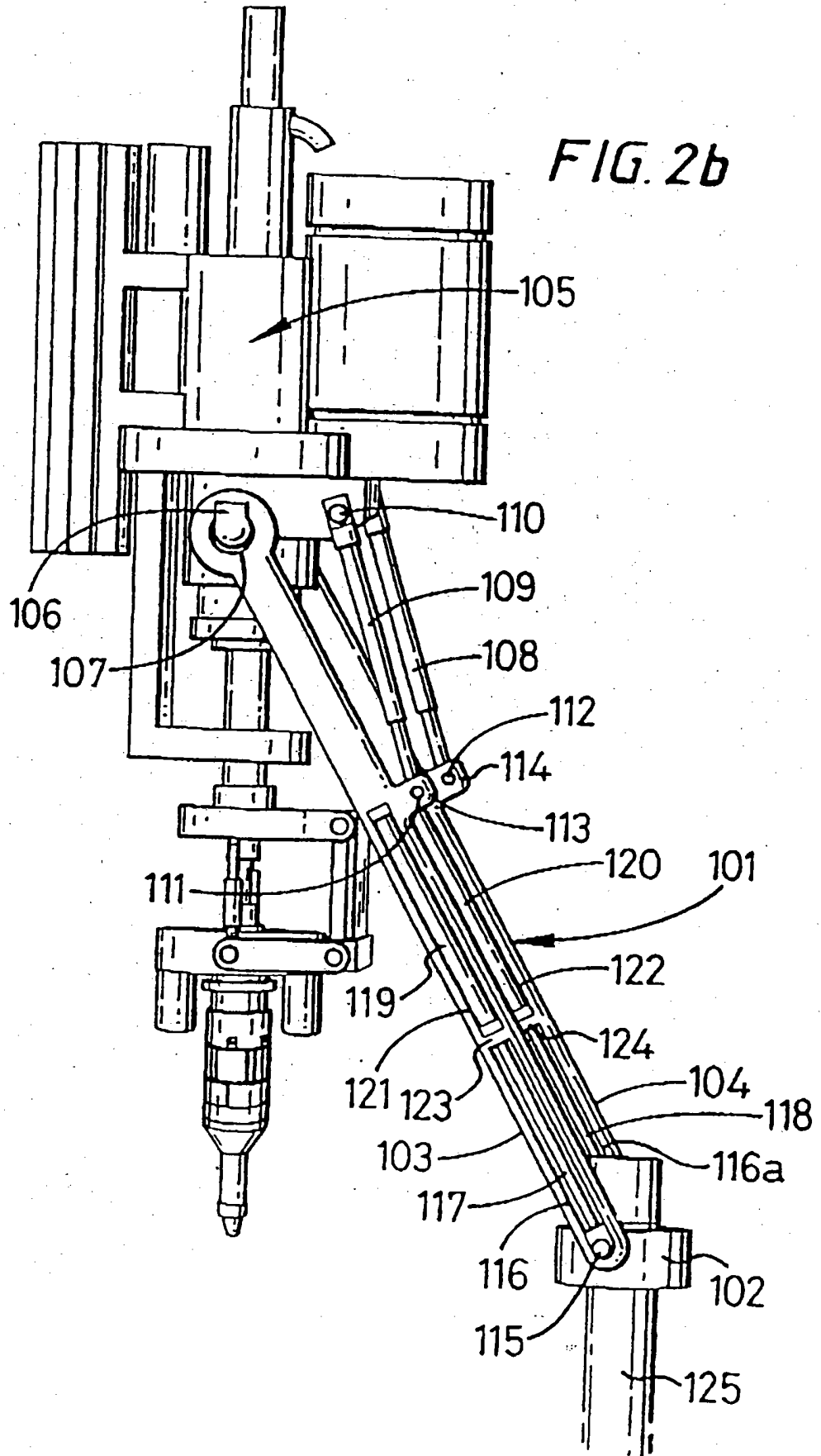


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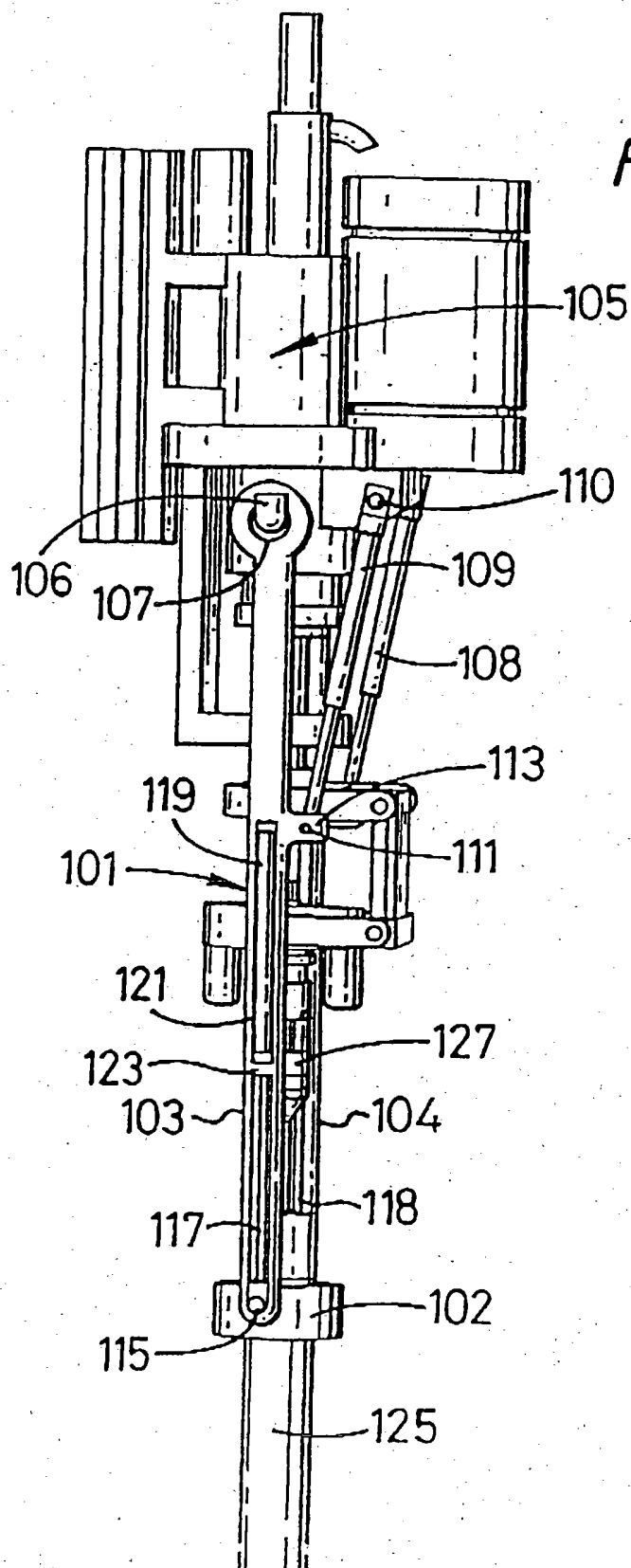
FIG. 2b





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FIG. 2c



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FIG. 2d

